A national Baumol–Oates tax on waste in Denmark helped achieve a reduction of 26% in net solid waste from 1987 to 1998. The tax, which is levied per ton of waste, was particularly effective as regards the heavier waste streams such as construction waste and garden waste. When it comes to industrial and commercial waste, there are indications that the waste tax is not sufficiently significant to induce changes in behavior, and that except for very waste-intensive enterprises, companies do not seem to be very price sensitive. For household waste, the impact of the tax can be improved where tariffs for garbage collection are weight based, rather than per unit. However, the waste sector is an area in which the price signals are modified and filtered by institutionalized practices in municipal administration, and in which true-cost pricing is not easy to achieve. Hence, the rational choice assumption of environmental economics needs to be supplemented by an institutional dimension to interpret responses to environmental taxes correctly.

**Key words** Economic instrument · Environmental policy · Waste management · Landfill tax · Incineration · Evaluation

### The introduction and design of the waste tax

The Danish waste tax was introduced on January 1, 1987, after a decision by the Danish Parliament. It applies to both household waste and industrial waste. The waste tax is a weight-based tax that is levied on all solid waste delivered to or processed at landfills and incinerators. It is a classic emission tax, and the revenue is not recycled but goes to the treasury. The rates of this tax are shown in Fig. 1; the tax increased from DKr 40/ton in 1987 to DKr 375/ton in 2000, with reduced rates for incineration. No attempt has been made to undertake a formal evaluation of the externalities associated with waste treatment. The tax is merely an instrument to affect behavior. As such, it should be seen as a tax that follows the principles of the classic standard-pricing approach (cf. Baumol and Oates).

Incineration is widespread in Denmark, and 82% of residual household waste is incinerated. The term “residual waste” denotes the amount of waste after reuse and recycling, i.e., the amount intended exclusively for landfills or incinerators. Of the total residual waste, 59% is incinerated. The background for the tax was an acute lack of landfill sites, especially in the greater Copenhagen metropolitan area, and problems with dioxin emissions from incineration. The tax was also meant to support the Action Plan for Waste and Recycling. The target of this plan was a recycling rate of 54% to be achieved by 1996. According to the then Minister of the Environment, Lone Dybkjær (Social Liberals), the waste tax was meant to be a “locomotive” for the action plan.

Waste that is reused or recycled is not liable to the tax, as the purpose of the tax is to promote such activities. For the same reason there is a general reimbursement mechanism, so that the tax is refunded for waste that is removed from registered waste sites. This is mainly relevant for construction and building materials, which can be reused, but also allows the operators of landfills to have other recycling activities within their domain.

The tax cannot be said to be targeted at preventing or minimizing waste. However, at the national level there are other more preventive economic mechanisms.

— Beer and soft drink packaging: producers must establish a deposit and refund system. This system has been in place since the nineteenth century.

— The deposit–refund system is supported by taxes on packaging containers for all drink products. This sup-
ports reuse and penalizes throwaway containers (introduced before the waste tax).

- A tax on disposable tableware (introduced before the waste tax).
- Rechargeable batteries: until 1995, there was an agreement with the producers to collect these, but due to lack of compliance a separate tax has been introduced.
- A raw material tax to limit the use of sand and gravel, and support the reuse of building materials for construction. This tax was introduced in connection with the waste tax.

See Danish Environmental Protection Agency publications for details on these environmental taxes.

**Theory and practice of price signals in the waste sector**

The collection of waste must take place according to a nonprofit-making cost-coverage principle, according to which the municipal authority can charge citizens for refuse disposal on the basis of its actual cost. The national regulations do not specify in any detail exactly how the municipality should charge its users, as this is left to local discretionary decisions. Usually a general fee is charged which covers all types of waste facilities, both for disposal and recycling. The fee is normally fixed in relation to the volume of the waste bin, and there are limited opportunities for choosing the size of the waste bin or the frequency with which it is collected. The incentive of the waste tax, which is charged on a weight basis, is therefore watered down by municipal user fees that that are charged on a per volume basis. Hence, for most households, increased recycling activity will not be reflected in a lower refuse collection fee.

The designers of the waste tax were well aware of this problem, and the argument behind the tax was not to influence the individual households, but rather “to make it more profitable for the refuse collection authorities in the municipalities to establish recycling and sorting systems.” In the legislative text, it was thus argued that “For every ton of waste delivered to recycling, the refuse collection authority will be able to save the corresponding tax.” The implicit assumption was that it would be possible to make the local and regional waste utilities optimize their behavior, disregarding their monopoly and the possibility of simply passing the tax on to the consumers.

**Pricing of collected waste**

For instructed waste, the municipalities normally instruct the waste producers as to which waste site they should take their waste to. According to the Environmental Protection Agency, the waste producers are free to take their waste products to any recycling site they prefer, although they are obliged to use the landfills and incinerators assigned by the municipality.

However, few waste producers take their own waste to the waste sites. They normally contract with transporters who are specialized in this service. There is often a tendering procedure by which the cheapest transporter is identified. The waste tax is then integrated into the bill of the waste transporter. The tax may not always be visible to the waste producer, even though it may make up nearly half of the bill for getting rid of the waste. However, some transporters present the tax bill from the waste site to prove that the waste has been disposed of legally.

The designers of the waste tax argued that “A tax on depositing and incineration of commercial waste will directly affect the individual company, which can save the tax and reduce its refuse disposal costs by sending its waste for recycling or by changing the production processes to produce less waste.” The price incentive from the waste tax for instructed waste is more likely to have a direct effect on the decisions of the waste producers than is the case with collected waste.